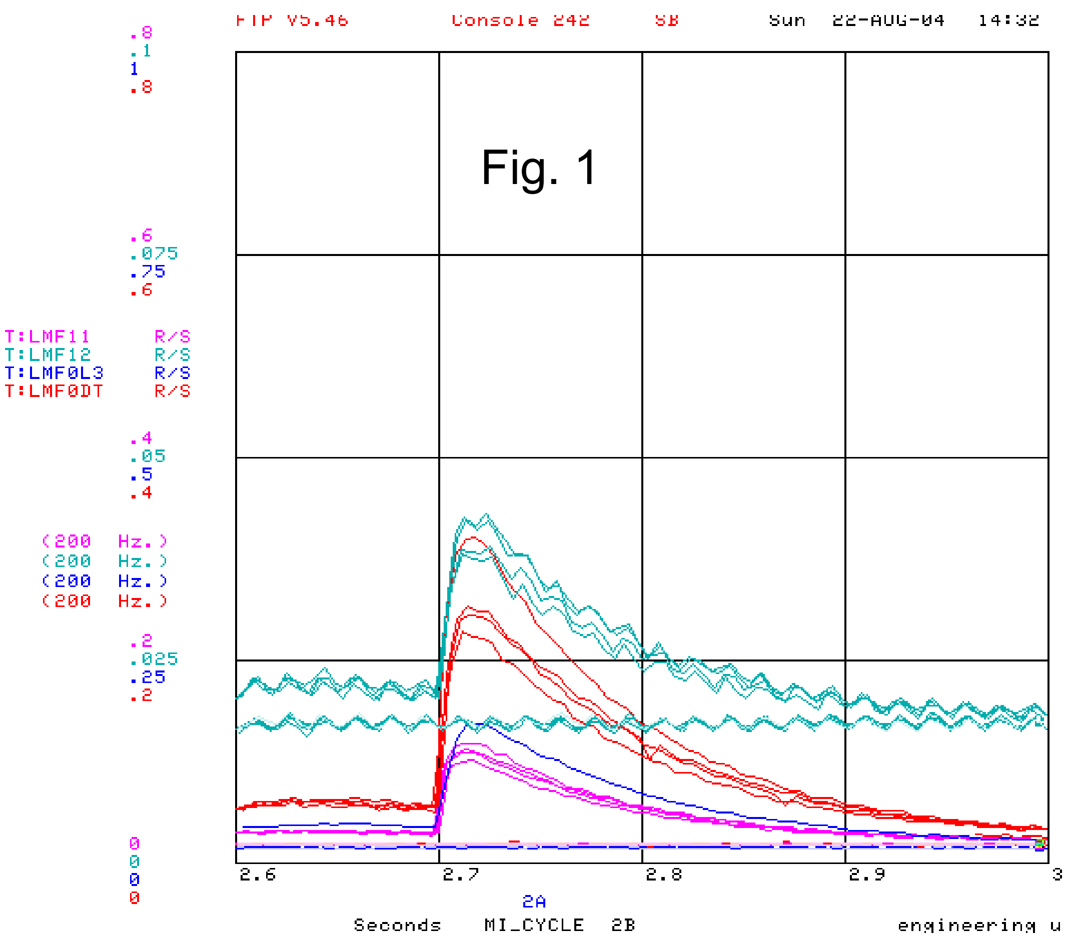
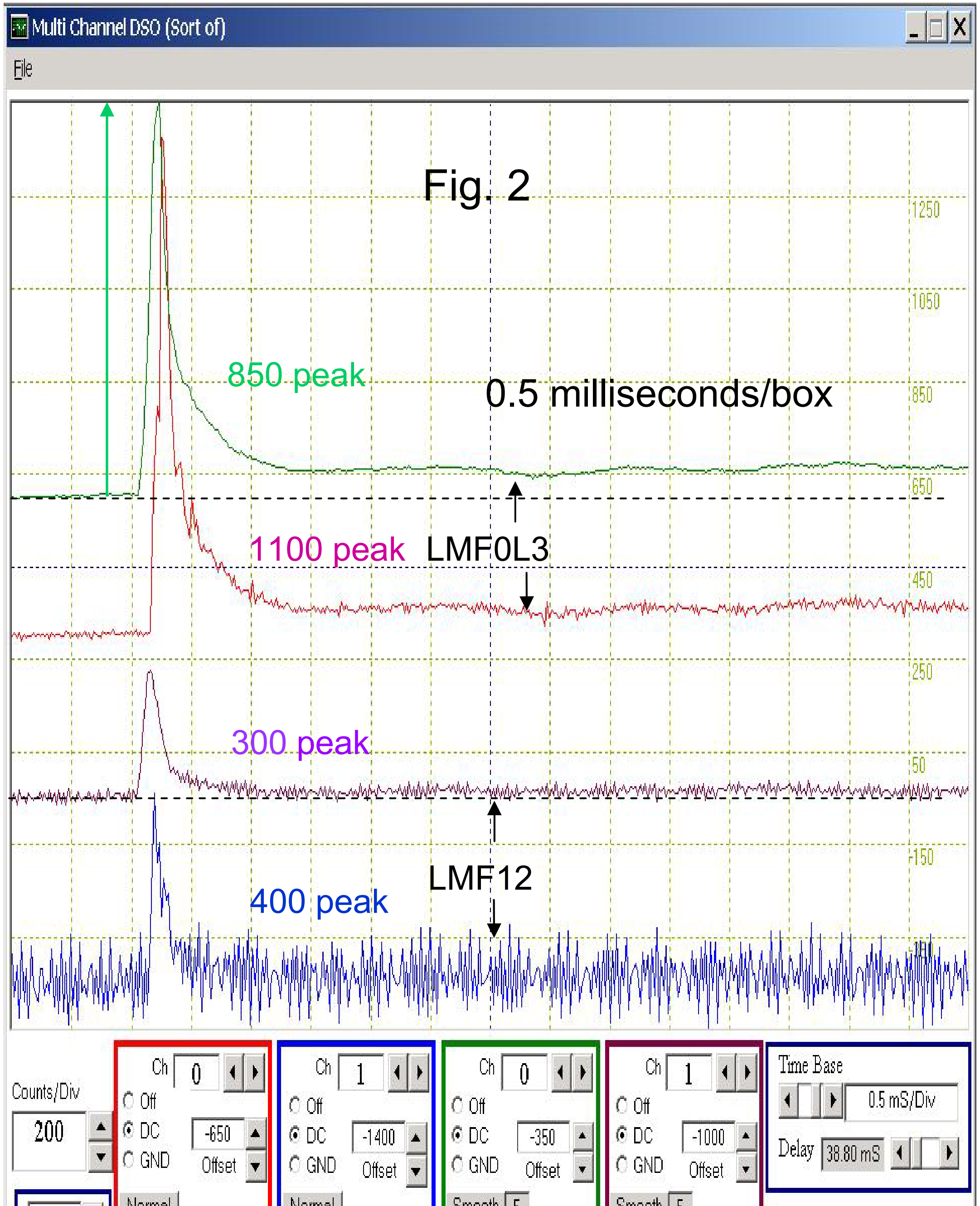
BLM system calibration:

The present BLM system reports in Rads/sec in ACNet. If we know this comes from an instantaneous (< millisecond) loss, the nominal factor to go from Rads/sec at peak to Rads is the time constant, 60 milliseconds, so Rads = Rads/sec x 0.06.



The data to the left come from proton injections for the last store in August 2004.
Loss monitor LMF12 has a peak loss of 0.025 rads/sec which implies a loss of 0.025 x 0.06 = 0.0015 rads or a charge of 105 pC;
loss monitor LMF0L3 has a peak loss of 0.1 rads/sec which implies a loss of 0.1 x 0.06 = 0.006 rads or 0.42 nC
- but see later



This shows the same loss monitors LMF0L3 and LMF12 read out by a new digitizer board. The 2nd and 4th trace down are the respective raw data; the 1st and 3rd traces are smoothed over 5 samples.

For the new digitizer,
65,536 counts = 10V x 100 pF
=> 1 count = 0.015 pC
LMF12 (2nd trace from bottom) has 300 x 5 = 1500 counts
=> q total = 22.5 pC
(new system)
Per R. Shafer, 1 rad = 70 nC,
=> 0.0015 rads = 105 pC
(present system)

so I am low by a factor of 5

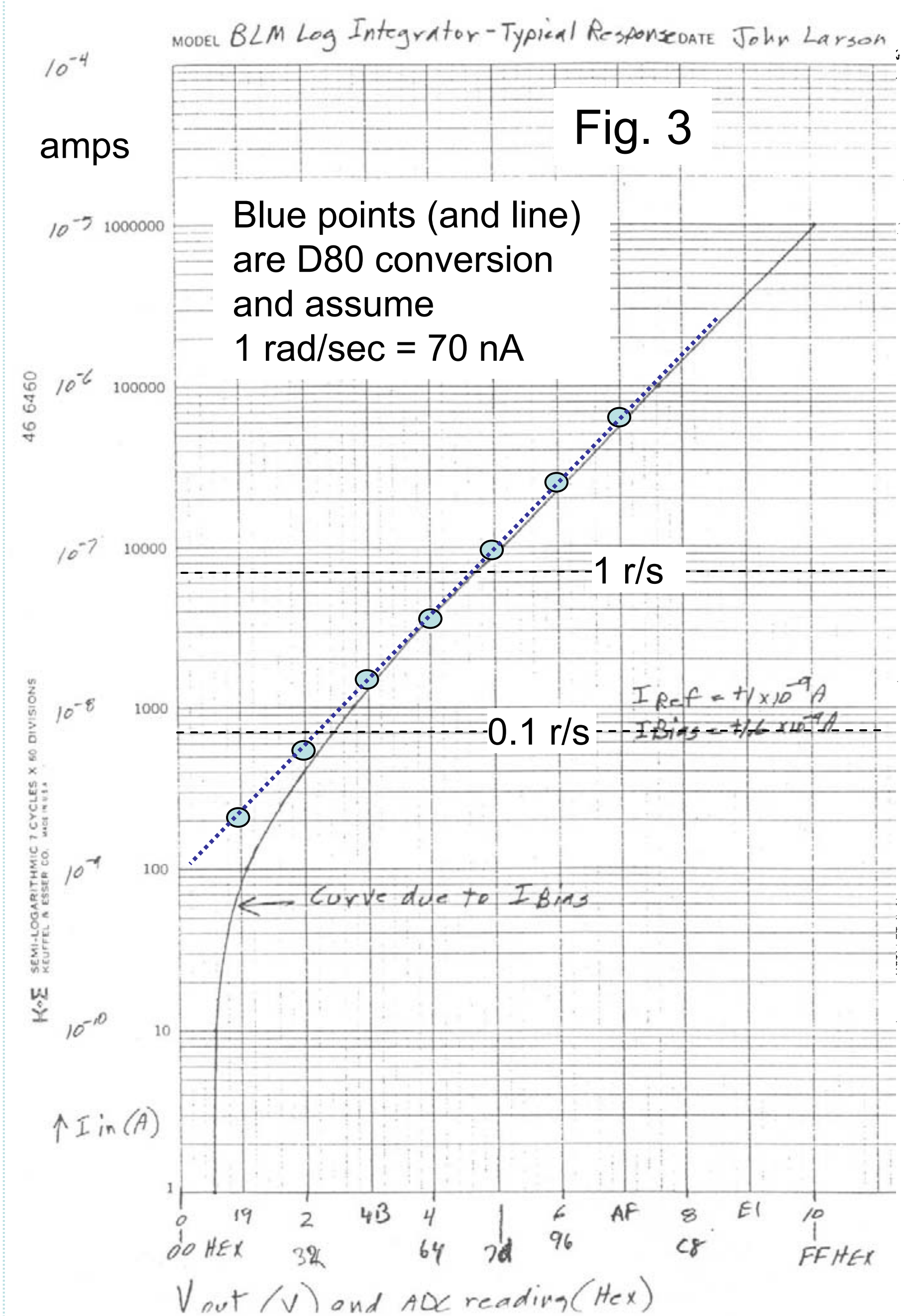
??????? Help !!!!!!!!!

The conversion used by ACNet to go from volts in the MADC to Rads/sec is: Rads/sec = 0.011 x 10 ^ (V/2.39)

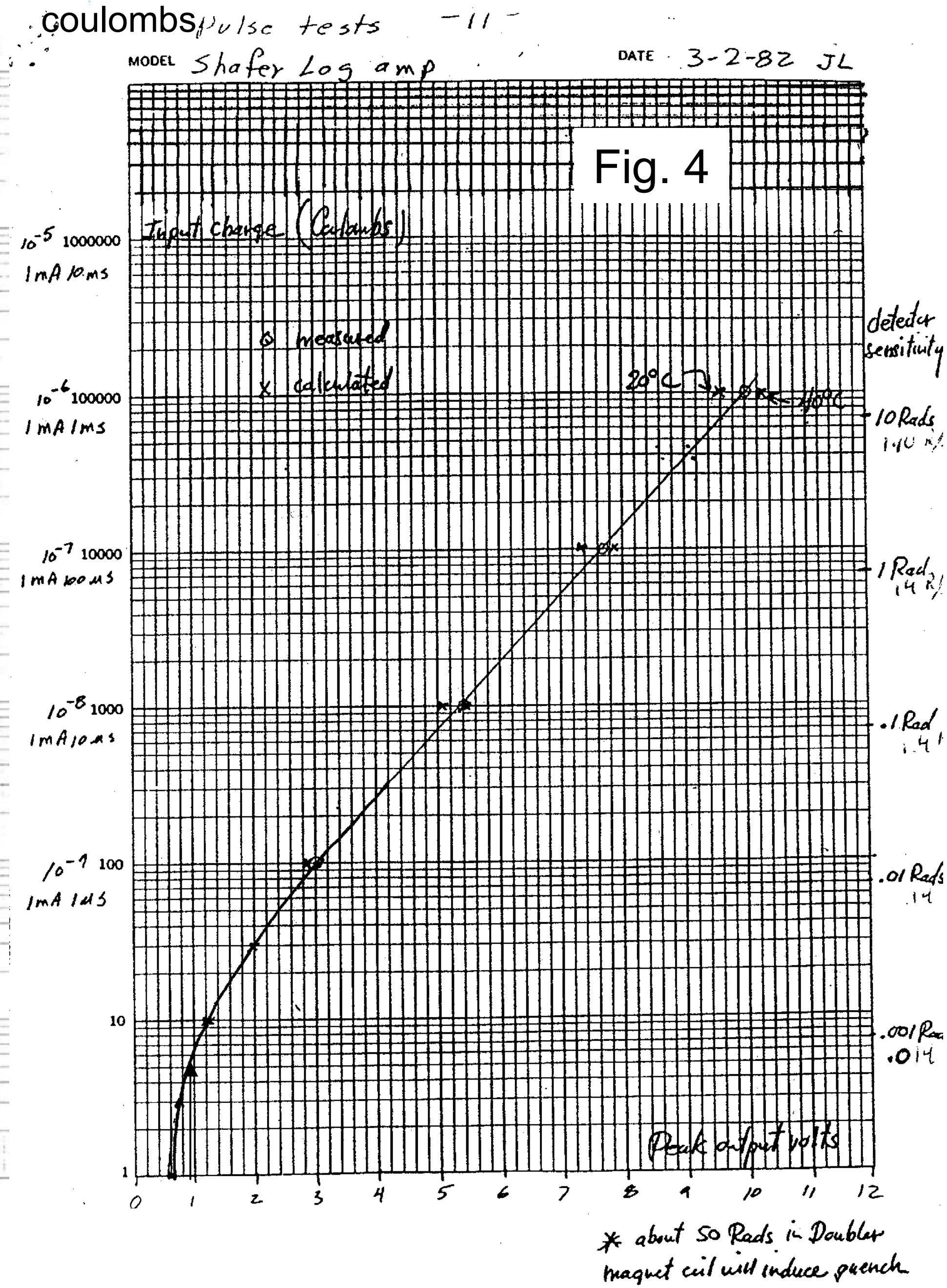
So a reading of 0.025 Rads/sec => V = 2.39 x $\log_{10}$(0.025/0.011) Volts
= 2.39 x 0.36 Volts
= 0.86 Volts

The plots on the next page show the actual output voltage vs the input current: the offset bias current has a significant effect below 2 Volts - the actual input from the BLM is more like 60 pC.. this helps to reconcile things.

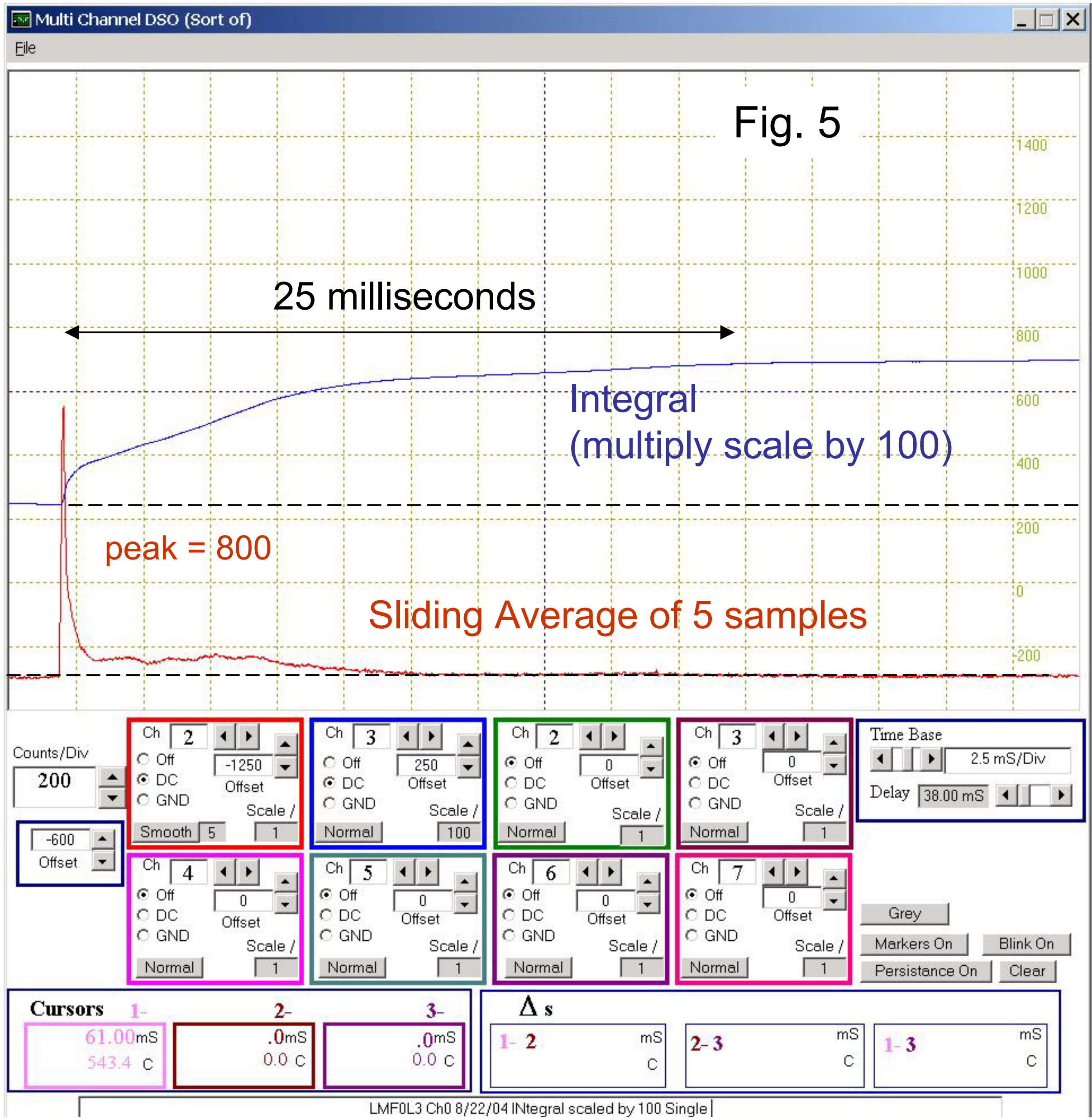
As important as this effect, however, is that the losses actually last a long time - and the estimate made by looking at the fast peak is rather misleading. The continuing losses are evident looking at the signal from LMF0L3 as seen in the new system in figure 2. The signal clearly does not return to its baseline after the initial spike. Figure 5 shows the integral of the LMF0L3 signal - a good 2/3 comes after the initial spike.



MODEL BLM Log Integrator - Typical Response DATE John Larson
Fig. 3
amps
Blue points (and line) are D80 conversion and assume 1 rad/sec = 70 nA
1 r/s
0.1 r/s
$I_{Ref} = +1 \times 10^{-9}$ A
$I_{Bias} = +1.6 \times 10^{-9}$ A
Curve due to I_{Bias}
↑ I in (A)
00 HEX
FF HEX
V out (V) and ADC reading (Hex)



coulombs
Pulse tests -11-
MODEL Shafer Log amp
DATE 3-2-82 JL
Fig. 4
Input charge (Coulombs)
1mA 10ms
1mA 1ms
1mA 100µs
1mA 10µs
1mA 1µs
⊗ measured
x calculated
20°C
40°C
detector sensitivity
10 Rads
1 Rad
.1 Rad
.01 Rads
.001 Rad
Peak output volts
* about 50 Rads in Doubler magnet coil will induce quench



The red is the loss of LMF0L3; the blue is the integral of the LMF0L3 loss (note the factor of 100 in the Scale/ box).

The baseline for the integral calculation is estimated using 833(=50 kHz/60) samples from the beginning of the sampling.

The loss lasts for 25 milliseconds during which we accumulate (700 - 250) *100 = 45,000 counts, 2/3 of them after the initial spike.

45,000 counts = 0.75 nC

If I look more carefully (ie with present knowledge) at the loss plot of the ***present*** BLM, a better estimate of the total loss is the peak x 100 milliseconds. This would imply a total loss of 0.01 Rads or a charge out of the BLM of 0.7 nC to be compared with the 0.75 nC from the new system.
The closeness of the two numbers is satisfactory - and I have learnt at least three things.

1) We need to treat low losses reported by the present system a little carefully.

2) It is hard with the present system to distinguish losses that last tens of milliseconds from instantaneous losses - obvious - and these losses show such behavior.

3) The digitizer scale is (at least roughly) correct and we can apply our minds to deciding the proper range. At present the biggest amount of charge we can take in one sample is 1 nC which corresponds to an ***instantaneous*** loss of 0.015 Rads; the largest ***continuous*** current we can take is 50 μA which corresponds to a loss of 700 Rads/sec. The latter is much larger than the present system - good; the former is much smaller than the present system - possibly bad.

Note that instantaneous in the new system means measured over 20 microseconds; for the present system instantaneous means less than 30 or so milliseconds. The new system as presently arranged can deal with 0.75 Rads in one millisecond.

The next page shows the loss rates presently set for aborting in the Tevatron.

Tevatron BLM Alarm/Abort Limits

10/19/04 1751

	LO FIELD		*HI FIELD*		*FAST EXTRACT*			
	ALARM	ABORT	ALARM	ABORT	ALARM	ABORT	DELAY	DURATION
A1	5.045	10.11	.1982	.9495	.7211	80.95	12609	12609
A2	5.045	10.11	.1982	.3972	.7211	80.95	12865	12865
A3	5.045	10.11	.1982	.3972	.7211	80.95	13121	13121
A4	5.045	10.11	.1982	.3972	.7211	80.95	13377	13377
B1	5.045	10.11	.1982	.3972	.7211	80.95	12610	12610
B2	5.045	10.11	.1982	.3972	.7211	80.95	12866	12866
B3	5.045	10.11	.1982	.3972	.6932	80.95	13122	13122
B4	5.045	10.11	.1982	.3972	.7211	80.95	13378	13378
C1	5.045	10.11	.2542	.5049	.7211	80.95	12611	12611
C2	5.045	10.11	.1982	.3972	.7211	80.95	12867	12867
C3	5.045	10.11	.1982	.3972	.7211	80.95	13123	13123
C4	5.045	10.11	.1982	.3972	.7211	80.95	13379	13379
D1	5.045	10.11	.1982	4.001	.7211	80.95	12612	12612
D2	5.045	10.11	.1982	.3972	.7211	80.95	12868	12868
D3	5.045	10.11	.1982	.3972	.7211	80.95	13124	13124
D4	5.045	10.11	.1982	7.714	.7211	80.95	13380	13380
E1	0	0	0	0	0	0	12613	12613
E2	5.045	10.11	.1982	.3972	.7211	80.95	12869	12869
E3	5.045	10.11	.1982	.3972	.7211	80.95	13125	13125
E4	5.045	36.05	.1901	.3816	.7211	80.95	13381	13381
F1	5.045	37.47	.1982	18.73	.6664	80.95	12614	12614
F2	5.045	10.11	.1982	.3972	.7211	80.95	12870	12870
F3	5.045	10.11	.1982	.3972	.7211	80.95	13126	13126
F4	5.045	10.5	.1982	.3972	.7211	80.95	13382	13382
A0	5.045	10.11	.2542	.5049	.7211	1.404	12353	12353
	4.854	10.11	.2439	.4852	.6932	1.404	16	250
B0	5.045	38.94	6.871	14.3	6.871	80.95	12354	12354
	9.356	33.38	.6406	15.44	6.871	80.95	16	250
D0	49.07	102	10.11	84.13	42.06	80.95	12356	12356
	47.21	102	196.3	196.3	42.06	80.95	16	250

Abort limits in the Tevatron are set at ~10 Rads/sec which implies 0.6 rads instantaneous loss.

If this loss is actually over one turn, this is 40 times bigger than anything the new system can measure. If it occurs over 1 millisecond or more, the new system can just cope.

This has prompted us to consider ways to increase the instantaneous loss capability of the system; see BeamsDoc 1417